Poster prepared for:

Effects from pile driving operations on harbour porpoises at Horns Reef offshore wind farm, monitored by T-PODs and behavioural observations

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Horns Reef Offshore Wind Farm

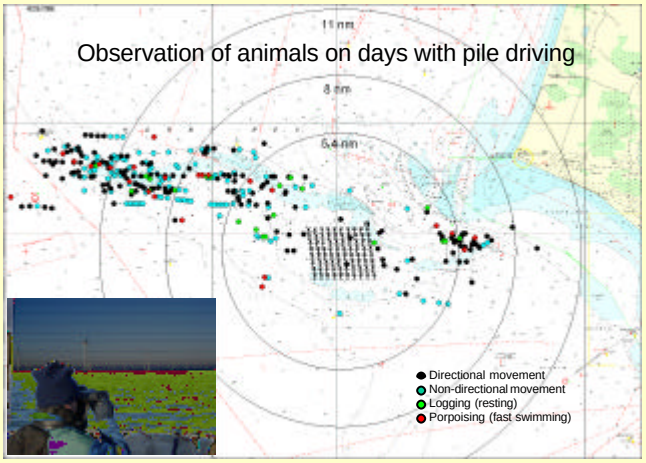
The wind farm was constructed in 2002 and is the largest offshore wind farm in the world. It is located at Horns Reef, approximately 20 km west of the Danish west coast.
The wind farm consists of 80 Vestas 2 MW turbines, mounted on steel monopiles.

Pile Driving and Mitigations

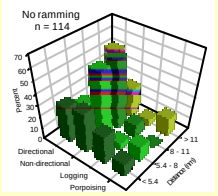
Monopiles were driven into the seafloor, generating very high sound pressures. Each operation took between 30 minutes and 2 1/2 hours

Mitigations used to prevent damage to marine mammals:
- Ramp up of impact energy
- Deployment of pingers (broadband 50-200 kHz signal, 153 dB re. 1 µPa @ 1m) and seal scarer (10 kHz signal, 170 dB re 1 µPa @ 1 m) about 30 minutes prior to each operation.

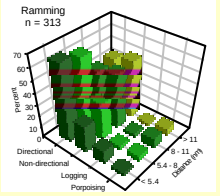
Behavioural Observations



Visual observations from ship along line transects were carried out on days with pile driving and days without pile driving. Behaviour of porpoises were separated in four categories: Directional movement, non-directional movement, logging (resting at the surface) and porpoising (fast swimming).

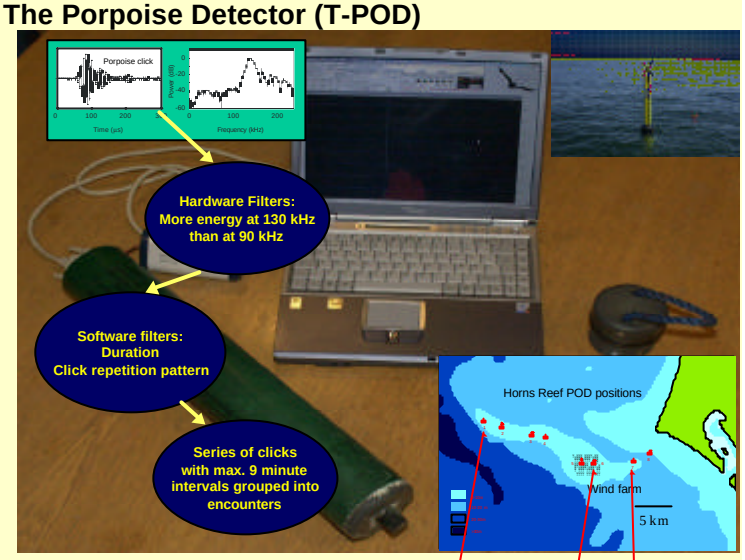


Behaviour on days without pile driving dominated by non-directional swimming (possibly feeding) No significant difference with distance to wind farm



Significant shift towards directional swimming on days with pile driving (c^2 = 21.3, P < 0.001). Behaviour significantly different with distance to wind farm

The Porpoise Detector (T-POD)



Acoustic datalogger that records clicks from harbour porpoises.
Sensitivity 100-200 meters, highly specific for porpoise signals
Deployed inside and outside the wind farm area during construction period.
Three stations (#1, #6 and #7) provided usable data on days with pile driving.

T-POD Recordings

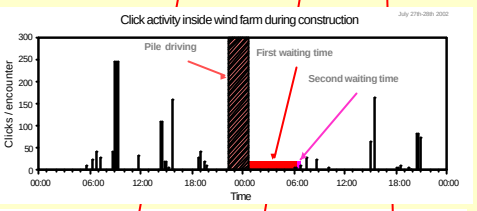
Time between encounters recorded on T-PODs were analysed.

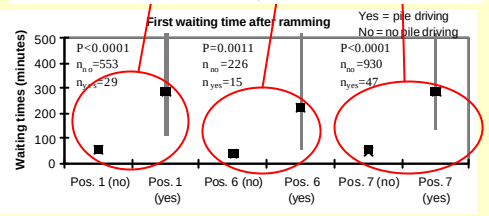
Mean waiting time without pile driving: 44 minutes (n = 1709)

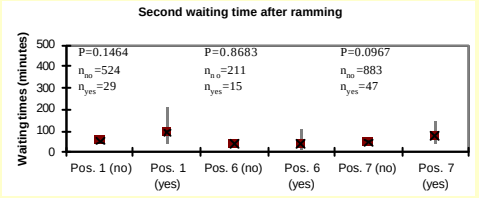
First waiting time after pile driving (time from end of operation to first encounter was significantly longer: 4.5 hours (n = 91)

Second waiting time (from first to second encounter) was not significantly different from mean waiting time outside pile driving operations.

Effect was seen on all three positions.







Conclusions

- Porpoises clearly affected by pile driving operations, evidenced both by changes in acoustic behaviour and surface behaviour
- Initial reaction to pingers/seal scarer likely (and desired!)
- Reaction seen across entire reef (T-PODs)
- Rapid recovery 2-3 hours after end of each operation
- T-POD powerful tool for impact study.

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References (available at www.hornsrev.dk):
Tougaard,J., Carstensen,J., Henriksen,O.D., Skov,H., & Teilmann,J. 2003: Short-term effects of the construction of wind turbines on harbour porpoises at Horns Reef. - DDH-Consulting, Roskilde, Denmark, 72 pp.

Tougaard,J., Carstensen,J., Henriksen,O.D., Teilmann,J. & Hansen, J.R. 2004: Harbour porpoises on Horns Reef – effects of the Horns Reef wind farm. National Environmental Research Institute, Roskilde, Denmark, 69 pp.